

Optimization of Domestic Waste Management Systems in India: A Review

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Abstract— Lately, the exponential population growth, high density of metropolitan regions, various cultures, changing food propensities, and ways of life have seen an unresolved issue as far as Solid Waste Management in India. Subsequently, the regions have been confronting numerous different issues identified with the assortment, treatment, and management of solid waste. The current investigation is a thorough survey summing up the current Solid Waste Management status distinguishing the related difficulties and determining possible answers for Solid Waste Management in the Indian context. The unsorted strong waste at source, social untouchable, citizen's demeanor, poor assessment, lacking potential systems disorderly casual area of waste, spontaneous financial, and helpless execution government arrangements. The conversation in this survey article finishes up, there is a pressing requirement for satisfactory treatment and reusing methodologies needed to be taken on according to the Indian solid waste arrangement. The proper implications of the expected answers for domestic solid waste at the concentrated and decentralized level need to be emphasized through different accessible logical treatment measures. Subsequently municipalities, alongside the inclusion of informal sectors, private organizations needed to zero in on setting out possible open doors and accomplish the drawn-out objective of the Solid Waste Management supportability for Indian cities.

Keywords: Domestic Waste, Impacts, Urban, Waste Management System, Environmental Benefits, Recycling, And Reuse, Fuzzy Logic

I. INTRODUCTION

Rising wages, quickly developing however impromptu urbanization, and changing ways of life have brought about expanded volumes and evolving pieces (expanding utilization of paper, plastic, and other inorganic materials) of city solid waste in India. The volume of waste is projected to increment from 64-72 million tons at present to 125 million tons by 2031. Untreated waste (a combination of biodegradable or wet waste and non-biodegradable waste) from Indian urban communities lies for quite a long time at dumpsites where land was initially allotted for creating landfills for safe removal of just the remaining waste. The decay of natural matter in the airless loads of waste at these dumpsites adds to an unnatural weather change by Green House Gas emanations. Since the current age of waste is additionally not dealt with adequately, it intensifies the issue. In a perfect world, the foundation and conveyance components for solid waste administration, seepage, sewerage, and wastewater treatment ought to be arranged and executed in a coordinated system of a city improvement plan. Other than focusing on enhance the prompt natural and general wellbeing emergencies coming about because of the current

exceptionally helpless condition of solid waste administration, there is a need for a plainly expressed medium-term technique to address the difficulties of solid waste administration in Indian urban communities.

The waste structure essentially affects waste administration rehearses. Big-time salary bunches use more bundled items, bringing about higher volumes of paper, glass, metals, plastics, and materials in contrast with low-pay bunches [1]. MSW may likewise contain unsafe wastes like paints, utilized medication, pesticides, E-wastes, and batteries.

II. LITERATURE REVIEW

In this segment an itemized conversation overwork of various creators in the field of waste administration. [3] Bishal Bharadwaj in 2021 examined forbidding single-utilized plastic packs as a famous strategy mediation among urban communities in agricultural nations. The strategy denotes some accomplishment in controlling plastic sack utilization, it defies two significant difficulties. To start with, the impact of the boycott regularly weakens and becomes incapable over the long run. Second, pack spillage could happen as clients change to unregulated plastic sacks and make more toxins. [4] Martyna Solis in 2020 Chemical reusing is viewed as an alluring innovative pathway for diminishing waste and ozone-depleting substance outflows, just as advancing roundabout economy. Family bundling streams will in general be of lower quality and lower reusing execution contrasted with modern and business waste streams, in this manner requiring specific consideration. [5] Akhilesh Kumar in 2020 examined that lately, the remarkable populace development, the high thickness of metropolitan regions, different culture, changing food propensities, and ways of life have seen an irritating issue as far as Municipal Solid Waste Management (MSWM) in India. Subsequently, the municipalities have been confronting numerous different issues identified with the assortment, treatment, and the board of solid waste. [6] Richard Kyere in 2019 explicitly examined the inclusion of the private area in solid waste administration and the nature of waste administration administrations. The investigation examined the exhibition improvement, administrative approach, and reasonable help conveyance of solid waste administration in the municipalities.

The investigation prescribes the adherence to regulating principles and concurred rules, reception, and utilization of proper expense recuperation systems for low-pay bunches just as the rebuilding of institutional arrangements to guarantee client contribution and authorization of enactment to work on city solid waste administration. [7] Mohamed Abdallah in 2019 clarified how brilliant waste assortment techniques have been created to

supplant regular fixed courses with dynamic frameworks that react to the genuine fill-level of waste receptacles.

The variety in waste age designs, which is the primary driver for the benefit of shrewd frameworks, is exacerbated in the United Arab Emirates (UAE) because of a high exile proportion. This prompts critical changes in waste age during breaks and occasional events. An activity cost decrease of 19% was accomplished with SCS contrasted with the customary situation. [8] Davide Tonini applies a base-up life cycle evaluation strategy to measure the ecological effects of the avoidable food waste created by four sectors of the food inventory network in the United Kingdom, be specific preparing, discount and retail, food administration, and families. The effects were measured for ten natural effect classifications, from Global Warming to Water Depletion, including roundabout land-use change impacts because of interest for land. [9] Alexander Kumi-Larbi examined that in many non-industrial nations low-thickness polyethylene (LDPE) sheets, sacks, and water sachets are a significant waste issue since neighborhood assortment and reusing frameworks don't exist.

Accordingly, LDPE has no worth and is unloaded causing tasteful, natural, and general medical problems. In this examination, waste LDPE water sachets have been liquefied and blended in with sand to shape LDPE-reinforced sand blocks. The impact of sand molecule size and sand to plastic proportion on thickness, compressive strength, and water absorption is accounted for. [10] Bhupendra Das examined that open consumption of metropolitan solid waste (MSW) is an inadequately portrayed and as often as the possible belittled wellspring of air contamination in non-industrial nations. A family review, a cut across walk overview, a trial to gauge the small portion of waste that is ignitable, a study on part of the populace consuming waste external their homes, and a study of the small portion of MSW consumed at dump destinations were acted in this examination. [11] S. Anwar in 2018 talked about Optimum metropolitan solid waste (MSW) the board framework is a fundamental viewpoint to be thought of. Ideal MSW the board framework could cause the significant expense of venture identified with its development, activity, and support.

An expense improvement model with the thought of area arranging is created to recognize the ideal design of the MSW the executive's framework with advancements thought about, for example, landfilling, fertilizing the soil, deny determined fuel, and reuse and reusing. [12] Kim Ragaert in 2017 examined a survey to presents a thorough depiction of the current pathways for reusing polymers, through both mechanical and substance reusing. The standards of these reusing pathways are outlined against current-day mechanical reality, by examining dominating modern advancements, plan methodologies, and reusing instances of explicit waste streams.

Beginning with an outline on sorts of solid plastic waste (SPW) and their starting points, the original copy proceeds with a conversation on the distinctive valorization choices for SPW. [13] Natália Pietzsch in 2017 thought about the developing worry with solid wastes issues and the squeezing need for a comprehensive way to deal with their administration, this investigation fostered a writing survey about the subject "Zero Waste". Keeping that in mind, a

deliberate writing survey was executed, through which 102 distributed articles were examined with the mean to, at first, grasp the idea of Zero Waste, and, then, at that point, map its advantages, challenges, and basic achievement factors. [14] Henry O. Addo in 2017 talked about the domestic waste age has contributed altogether to hampering public waste administration endeavors. It presents a genuine danger to the public turn of events and requires appropriate treatment and the executives inside and outside families.

The issue of ill-advised waste administration has consistently been a test in Ghana, convincing a few public studies to investigate the act of waste administration. In any case, little is thought about how much waste is produced and overseen inside families and there is a genuine shortage of data for public arrangement and arranging. [15] Atiq Uz Zaman in 2016 this paper introduced the ecological and monetary advantages of worldwide waste administration frameworks with regards to zero waste practices. The examination dissected the waste administration execution of 168 nations throughout the planet and assessed their presentation utilizing the zero-waste apparatus. The Zero Waste Index estimates the material replacement capability of waste. This is finished by considering the number of materials recuperated from waste, which conceivably substitute the interest for virgin materials. [16] Rajkumar Joshi in 2016 talked about that the wretched condition of and challenges in metropolitan solid waste administration (MSWM) in metropolitan India is the inspiration of the current examination.

Urbanization contributes to improved civil solid waste (MSW) age and informal treatment of MSW debases the metropolitan climate and causes wellbeing dangers. In this paper, an endeavor is made to assess the significant boundaries of MSWM, notwithstanding an exhaustive audit of MSW age, its portrayal, assortment, and treatment alternatives as drilled in India. [17] Yalin Yuan in 2015 talked about a source division program for family kitchen waste that has been set up in Beijing since 2010. In any case, the interest pace of occupants is a long way from agreeable. This investigation was completed to distinguish occupants' inclinations dependent on a further developed administration procedure for family kitchen waste source division. We decide the inclinations of inhabitants in a specially appointed example, as indicated by their age level, for source partition administrations and their minor eagerness to acknowledge pay for the assistance ascribes. The outcomes show there are contrasts of inclinations on the administration's credits between youthful, center, and advanced age inhabitants. [18] Pote et al. - in 2015 In this paper composing overview was coordinated, of time, storing, treatment and move, with covering thoughts of family waste organization – waste evasion, assembling, reusing, and reuse. The examination shows that there is a low degree of nuclear family care about the regular implications of private transportation implanted between periods if required. [19] Dr. Raveesh Agarwal in 2015 contemplated the current practices identified with the different waste administration drives taken in India for human prosperity. The other intention is to give a few ideas and proposals to further develop the waste administration rehearses in Indian towns.

This work depends on auxiliary examination. Existing reports identified with waste administration and proposals of organizers/NGOs/specialists/government responsibility offices/key industry specialists/for further developing the framework are contemplated. The paper endeavors to comprehend the significant pretended by the proper area occupied with waste administration in our country. This work is unique and could be additionally expanded. [20] Rametta Massa Yoda et al. in 2014 introduced the aftereffects of the investigation uncovered that 93.1% of families discarded food garbage as waste and 77.8% discarded plastic materials as waste. The investigation additionally showed that 61.0% of the families discarded their waste at local area canisters or had waste gotten up homes by private workers for hire.

The leftover 39.0% discarded their waste in drains, roads, openings, and close-by brambles. Of the individuals who paid for the administrations of private workers for hire, 62.9% were not happy with the administrations as a result of their expense and unpredictable assortment. About 83% of the respondents knew that ill-advised waste administration adds to illness causation; the vast majority of the respondents felt that inappropriate waste administration could prompt jungle fever and the runs. [21] Paula Mendes in 2013 introduced an assessment of metropolitan solid waste (MSW) administrations utilizing the executive's frameworks is significant for working on the nature of such administrations.

In this examination, focus on and select execution pointers (PIs) for MSW administration assessment and sort out them in a Balanced Scorecard (BSC) apparatus. [22] Christopher J. Koroneos in 2012 Innovative systems are expected to manage the waste we produce today to keep it from messing up people in the future. As waste administration issues acquire public mindfulness, concern has ascended about the fittingness of different removal strategies. The target of this work is the natural appraisal of various metropolitan solid waste treatment methodologies for the city of Thessaloniki, inside the methodological systems of Life Cycle Assessment (LCA) and the Integrated Solid. [23] W Abeyewickreme in 2008 examined that waste administration through local area activation to lessen reproducing places at the family level could be a powerful and maintainable dengue vector control methodology in regions where vector rearing happens in little disposed of water holders.

Author	Year	Conclusion derived
B. Bharadwaj et al.	2021	the article concludes that Enforcing a ban reduces plastic bags immediately, but reducing the total bag takes time.
M. Solis et al.	2020	the article concludes that Chemical recycling is only a part of the solution for plastic recovery.
A. Kumar et al.	2020	the article concludes that there is an urgent need for adequate treatment and recycling strategies required to be adopted as per the Indian solid waste composition.
R. Kyere et al.	2019	Recommends use of appropriate cost recovery strategies for low-

		income groups as well as the restructuring of institutional arrangements to ensure user involvement
M. Abdallah et al.	2019	The study proposes an integrated SCS architecture and explores critical considerations of smart systems
D. Tonini et al.	2018	Better data on the breakdown of the food products composing the waste is needed
A. Kumi-Larbi et al.	2018	LDPE is a problem in developing countries because of limited local recycling options. Simple and appropriate technology produces new materials from LDPE-bonded sand.
B. Das et al.	2018	MSW open burning practices are more prevalent in the sub-urban area than municipality core. Lower waste collection efficiency reveals a higher fraction of the population burning MSW
S. Anwar et al.	2018	A mixed-integer linear programming (MILP) model is developed to perform the optimization. The results showed that an increase in the type and degree of treatment increases the net profit
K. Ragaert et al.	2017	This paper reviews the current pathways for recycling of solid plastic waste, via both mechanical and chemical recycling
N. zanzsch et al.	2017	This paper reviews the current pathways for recycling of solid plastic waste, via both mechanical and chemical recycling
H. O. Addo et al.	2017	The study reveals that there is no proper management of domestic waste except in few households that segregate waste.

Table 1: Summary of literature review

III. SOLID WASTE MANAGEMENT

Solid waste alludes to the scope of trash materials—emerging from the creature and human exercises—that is disposed of as undesirable and futile. Solid waste is produced from mechanical, private, and business exercises in a given region, and might be dealt with in an assortment of ways. In that capacity, landfills are regularly named sterile, city, development and destruction, or modern waste destinations.

Waste can be classified as dependent on material, like plastic, paper, glass, metal, and natural waste. The arrangement may likewise be founded on peril potential, including radioactive, combustible, irresistible, poisonous, or non-harmful materials. Classifications may likewise relate to the beginning of the waste, regardless of whether modern, domestic, business, institutional, or development and destruction.

Notwithstanding the beginning, content, or danger potential, solid waste should be overseen methodically to guarantee ecological prescribed procedures. As solid waste administration is a basic part of ecological cleanliness, it should be joined into natural arranging.

The essential objective of solid waste administration is lessening and killing the antagonistic effects of waste materials on human wellbeing and the climate to help monetary turn of events and unrivaled personal satisfaction. This is to be done in the most proficient way conceivable, to minimize expenses and forestall waste development [26].

IV. STATUS OF WASTE MANAGEMENT IN INDIA

The generated amount of MSW additionally relies upon expectations for everyday comforts, extent, kind of business movement, dietary patterns, geological, and environmental conditions. Transients looking for promising circumstances demolish the circumstance. According to the new information from MNRE Report, India is producing dramatically around 145 million tons of waste each year and is further expected to reach roughly 260 to 300 million tons each day in the year 2047. According to the CPCB, India data, around 117,644 MT gathered, and around 49,401 MT is just treated.

According to the assessment, waste dumps require a land space of 1400 sq. Km around continuously 2051. Alluding to fig.1, generation of waste, land prerequisite, and the populace development with time have reached past, additionally began making a shortage of accessible dumpsites.

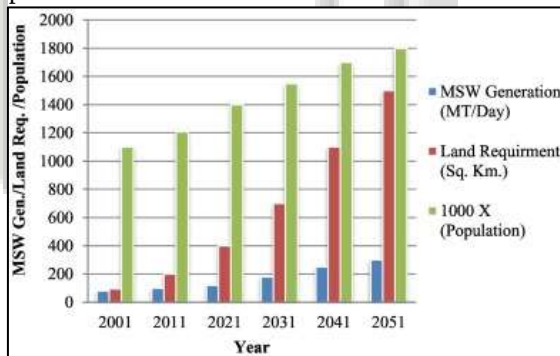


Fig. 1: MSW age, land prerequisite, and population projection from 2001 to 2051 [2]

All out 378 Urban Local Bodies and 05 Cantonment Boards are answerable for the execution of SWM Rules, 2016 in the State. Total waste generation in the State is around 8000 TPD, out of which 7500 TPD waste is gathered and 6100 TPD is dealt with, and the rest 1400 TPD is landfilled. It is accounted for that there are 378 landfill destinations present and 4 landfill locales are under development. 378 dumpsites are existing in the State and 01 dumpsites have been changed over to Sanitary Landfill. Great practices like the house-to-house assortment are being consented to by 364 ULBs. Isolation of waste is done in 249 ULBs in particular. In Madhya Pradesh, 276 ULBs have storage space and 364 ULBs are practicing covered transportation of waste. 36 towns have treated the functional soil offices, 16 towns are having vermi-compositing offices, which are functional. One Biogas plant was introduced at Bhopal, one Refused Derived Plant (RDF) is introduced at Ujjain and one waste to energy

plant having a limit of 400 TPD is introduced in Jabalpur [27]. Alluding to Fig. 2, the piece of waste in a run of the mill Indian urban community is

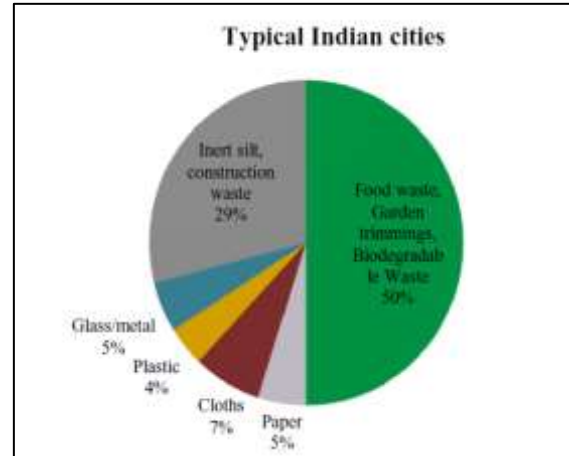


Fig. 2: Composition of India waste [2]

V. PROPOSED METHODOLOGY

Fuzzy sets have supplanted the likelihood hypothesis to address the vulnerabilities of real-world issues. The issue with the likelihood hypothesis accompanies reality that they can deal with just a single vulnerability, which is supplanted fuzzy sets presented by prof. L.A. Zadeh in the year 1965. For instance: let take the tallness of an individual. In the event of a crisp set just two cases emerge:

$$\text{Height} = \begin{cases} \text{Tall} \\ \text{Short} \end{cases}$$

Presently assuming somebody's stature is tall, participation esteem is 1 else worth will be 0. While the same issue when addressed in fuzzy rationale. The stature of an individual can have a wide range of classifications with various people groups have various options over it for similar tallness of individual. For instance, in east India the normal tallness is typically 5'6". Henceforth for them, an individual with a tallness of 5'10" is tall though the same individual for individuals of Punjab or Haryana were normal stature is 5'10" is of normal stature. Henceforth same tallness of any individual can be classified diversely by various individuals.

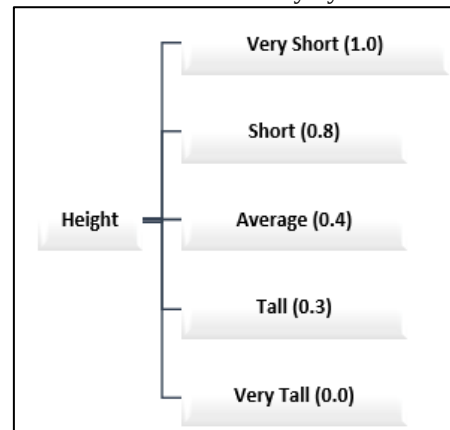


Fig. 3: Case representation in fuzzy logic with membership value

Here in the above figure membership function value denotes the degree of belongingness. Representation of Fuzzy Set:

$$A(x) = \{x, \mu_A(x), x \in X\}$$

μ denotes membership value (valued between 0.0 to 1.0)

The likelihood is the recurrence of the probability that a component is in a class. Enrolment is the likeness of a component to a class. In the further area, we will comprehend the contrast between the two, with the assistance of a model.

Assume we need to purchase red apples. Presently the principal thing that will be our anxiety is the accessibility of apples on the lookout. This issue will be taken care of by likelihood. Though the apple we purchased will be red or not have a few vulnerabilities in it which can be tackled utilizing fuzzy with the assistance of participation work.

In this square graph of Mamdani approach of fuzzy rationale regulator, fuzzification module address the way toward deciding enrollment work worth of any info order. After this module, the outcome is provided to fuzzy interface motor where this outcome is contrasted and fuzzy principle base and all terminated standards are considered for additional estimation of yields.

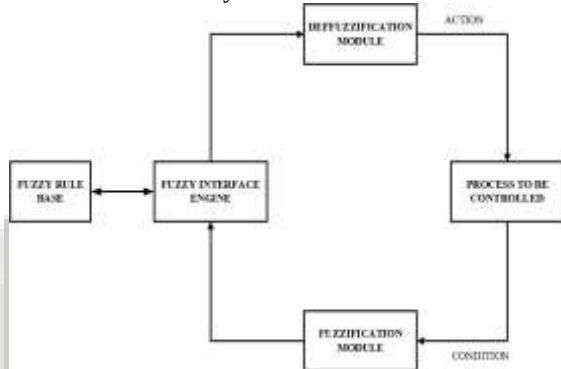


Fig. 4: Block Diagram of Mamdani approach of FLC

These outputs are fuzzified. Now to obtain crisp output we will use the defuzzification module. Hence an appropriate action in the form of this output is obtained. To calculate the fuzzified output corresponding to all fired rules, the “OR” operator (or max function) is used.

The underneath figure addresses the means engaged with utilizing fuzzy rationale. The work begins with the characterizing of information sources and yields for the given issue. Presently every one of these sources of info and yields should be addressed as individual participation work with various reach and distinctive width of various classes, making every enrollment work remarkable for the specific information boundary.

In the wake of characterizing enrollment work, the subsequent stage is to foster guideline base utilizing information base by well-qualified assessment. These guidelines are characterized dependent on assuming, contingent explanation. When these principles are shaped a reproduction is done dependent on info and yield data. Given this data, the mistake is determined on the anticipated and genuine worth of yield boundary. After assessment of the mistake, an examination is finished with the necessary ideal blunder esteem. Assuming objective is reached, no further preparation is required and the cycle will end, in any case, further tuning of the interaction is done to further develop the result and the same advances are followed once more.

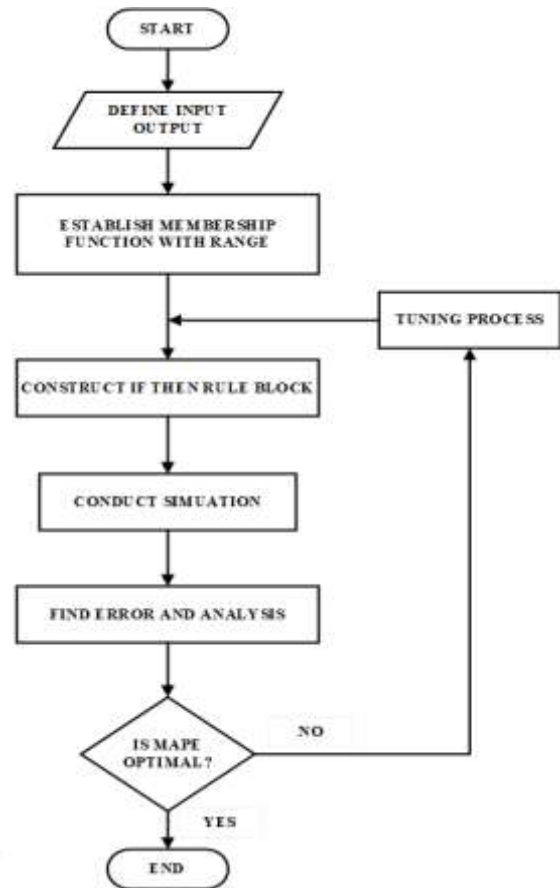


Fig. 5: Flow chart for the fuzzy logic model.

VI. CONCLUSION

In this paper, a detailed conversation over the significance of domestic waste administration is done effectively. For doing as such different works are done already is concentrated in writing survey. The paper additionally introduced Fuzzy rationale as a proposed answer for enhancing the waste administration measure by acquiring its capacity to discover the connection between nonlinear data with the assistance of a set of rules dependent on etymological factors. The exact expectation of waste age assumes a vital part in arranging of Solid Waste Management (SWM) framework. A numerical model will be created in future work to foreseeing the Residential Solid Waste (RSW) age utilizing fuzzy rationale. The family populace, yearly pay, and building space of families will be considered as autonomous factors for anticipating RSW generation.

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